having found, from several experiments, that a red heat is not sufficient to expell all the matter capable of being volatilized.

Mr. Davy then made some experiments to determine whether any portion of fixed alkali existed in this mineral, but no indications of such alkali could be observed.

The fluid obtained by distilling several different specimens of this mineral was similar in its properties; the only test of the presence of acid matter in it was litmus paper; and in some instances the effect upon this paper was scarcely perceptible. Mr. Davy made several experiments to determine the nature of the above acid matter, but without success.

It is, however, he says, evident that it is not any one of the known mineral acids: he is also disposed to believe, that it is not an essential component part of the mineral, but that, as well as the oxide of manganese, the oxide of iron, and the lime, it is only an accidental ingredient. Hence the mineral, when in a state of purity, must, he thinks, be considered as a chemical combination of about 30 parts of water, and 70 of alumine.

The diaspore, which has been examined by M. Vauquelin, loses 16 or 17 parts in the 100 by ignition, and contains nearly 80 parts of alumine, and 3 of oxide of iron. It is supposed by M. Vauquelin to be a compound of alumine and water. But its characters are very different from those of the mineral here described; and the nature of the part volatilized by heat has not yet been ascertained.

A mineral similar to that here treated of has been found near St. Austle in Cornwall; and Mr. Davy has been informed that, according to an analysis of it made by the Rev. William Gregor, it appears to consist of similar ingredients.

Dr. Babington has proposed to call this mineral by the name of Wavellite, from the gentleman who discovered it in Devonshire; but if a name founded upon its chemical composition should be preferred, Mr. Davy thinks it may be denominated Hydrargillite.

Experiments on Wootz. By Mr. David Mushet. *Communicated by the Right Hon. Sir* Joseph Banks, *K.B. P.R.S.* Read February 14, 1805. [*Phil. Trans.* 1805, *p.* 163.]

The fine cakes of the kind of steel called Wootz, which form the subject of the present paper, were delivered to Mr. Mushet, for the purpose of examination, by Sir Joseph Banks. Mr. Mushet begins his account of them by giving a very minute description of the form, the grain, and every other external character of these cakes. This description cannot well be abridged, and is too long to be repeated. We shall therefore only say that Mr. Mushet states, as a general remark, that the grain and density of these cakes of wootz were uniformly homogeneous, and free from metallic iron towards the under or round surface, but that they were always the reverse towards the upper side, called by Mr. Mushet the feeder.

The appearances observed upon forging these cakes are then par-

ticularly described, from which Mr. Mushet deduces the following general remarks.

The formation of wootz, he says, appears to him to be in consequence of the fusion of a particular ore, which he supposes to be calcareous, or to be rendered so by a mixture of calcareous earth, along with a portion of carbonaceous matter. The fusion, he thinks, is performed in a clay vessel or crucible, in which vessel the separated metal is allowed to cool. Hence, in his opinion, arises the crystallization that occupies the pits and cells observed in and upon the under or round surface of the cakes.

The want of homogeneity and solidity in these cakes, appears to Mr. Mushet to be owing to the want of a sufficient degree of heat to effect a perfect reduction; and this opinion, he thinks, is strengthened by observing, that those cakes which are the hardest, or which contain the largest portion of carbonaceous matter, and, of course, form the most fusible steel, are always the most solid and homogeneous; while, on the contrary, those cakes which are the most easily cut by the chisel, are in general cellular, and abound with veins of malleable iron. If the natives of the country which produces the wootz were capable of rendering it perfectly fluid, Mr. Mushet thinks they would certainly have run it into moulds, by which, he says, they would have acquired a kind of steel more uniform in its quality, and more fit for the purpose of being worked and applied to the arts.

Some of the cakes here described had, around the feeder, and upon the upper surface in general, evident marks of the hammer. This appearance Mr. Mushet accounts for by supposing, that when the cake was taken from the pot or crucible, the feeder was most probably slightly elevated, and the top of the cake covered in part with small masses of ore, which, from want of a sufficient degree of heat, had not been perfectly fused. These, he thinks, are cut off at a second heating, and the surface then hammered smooth, to make the cakes more fit for sale. Mr. Mushet says he has observed similar appearances in operations of a like nature, where the heat has been insufficient; and that such phenomena sometimes take place in separating crude iron from its ores, when, from its containing an excess of carbon, it is difficult to be fused.

The division of the cakes, by the native manufacturer, he thinks, is done merely to facilitate its subsequent application to the purposes of the artist, and to serve as a test of the quality of the steel.

In order to determine by direct experiment whether wootz owes its hardness to an excess of carbon, Mr. Mushet made some comparative experiments upon the cakes, and upon common cast steel and white cast iron. In operations of this kind, he says, he has always found the proportion of carbon best ascertained by the quantity of lead reduced from flint glass. He therefore mixed a certain quantity of wootz, or of steel, or iron, with three times the weight of pounded flint glass, and exposed the mixture to a heat of 160° of Wedgwood's pyrometer.

The result of these experiments was as follows:—

The wootz of the 1st cake reduced 0·139 its own weight of lead.
That of the 2nd ——— 0·125 ——— ———
——— 3rd ——— 0·120 ——— ———
——— 4th ——— 0·156 ——— ———
——— 5th ——— 0·102 ——— ———
Steel containing $\frac{1}{60}$ its weight of carbon 0·094 its own weight of lead.
White cast iron ——— ——— ——— 0·228 ——— ———

From these experiments, the author says, it appears, that wootz contains a greater proportion of carbonaceous matter than the common sorts of cast steel, and that some particular cakes approach very near to the nature of cast iron. This, added to the imperfect reduction, seems to him quite sufficient to account for its refractory nature, and for the want of homogeneity in its texture.

Notwithstanding the above imperfections, Mr. Mushet thinks wootz possesses the radical principles of good steel, and that it is impossible not to have a very high opinion of the excellence of the ore from which it is produced; the possession of which, for the fabrication of steel and bar iron, would be an object of the highest importance. It is, he says, a subject of regret that such a source of wealth cannot be annexed to the dominions of this country; as in that case the East India Company might supply their settlements with an article superior in quality, and inferior in price, to any they send from this country.

Abstract of Observations on a diurnal Variation of the Barometer between the Tropics. By J. Horsburgh, *Esq. In a Letter to* Henry Cavendish, *Esq. F.R.S.* Read March 14, 1805. [*Phil. Trans.* 1805, *p.* 177.]

It appears from Mr. Horsburgh's journal, that in steady weather, within the tropics, a regular elevation and depression of the barometer takes place twice in every twenty-four hours, the greatest depression being about four o'clock morning and evening, and the greatest elevation being from eight in the morning till noon, and from nine or ten in the evening till midnight.

In a letter which accompanies the journal, dated Bombay, April 20th, 1804, Mr. Horsburgh says he has observed, since his arrival in India, that the atmosphere appears to affect the barometer differently at sea from what it does on shore. As a proof of this, Mr. Horsburgh gives a series of observations, made on two barometers, one by Troughton, the other by Ramsden, of which the following is an abstract.

From the time of leaving the Land's End, on April 19th, 1802, the mercury was fluctuating and irregular, till April 29th, lat. 26° N., long. 20° W., when it constantly performed two elevations and two depressions every twenty-four hours. These Mr. Horsburgh calls equatropical motions. From lat. 26° to 10° the difference in the high and low stations of the mercury was not so great as it was from